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Quick Answers

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John Pumford, AuD, Aud(C), Reg. CASLPO

Question:

"If You are Performing an Insertion Gain Measurement, Do You Need to Subtract the REUR If It's a Non-occluding Fitting?

Answer:

Non-occluding fittings present unique challenges and considerations when conducting real-ear measurements (REM). For clinicians who subscribe to the insertion gain method for verifying devices to prescriptive targets, confusion can arise regarding how to properly account for the real-ear unaided response (REUR) or real-ear unaided gain (REUG), given it is typically not impacted with open fittings. First, to address this concern, let's clarify the terminology and calculation approach. As noted in Pumford (2018), insertion gain requires subtraction of the REUR (i.e., SPL across frequencies of the open ear canal for a given input signal) from the real-ear aided response (REAR) (i.e., SPL across frequencies of an activated hearing aid in the ear canal for a given input signal). That is REIG = REAR – REUR and is represented on REM systems, as shown in Figure 1 below. As it relates to the topic at hand, we can observe in Figure 2 below how the coupling selected as part of the fitting can impact the REUG, and hence lead to questions regarding whether modifications need to be made to the verification calculation.

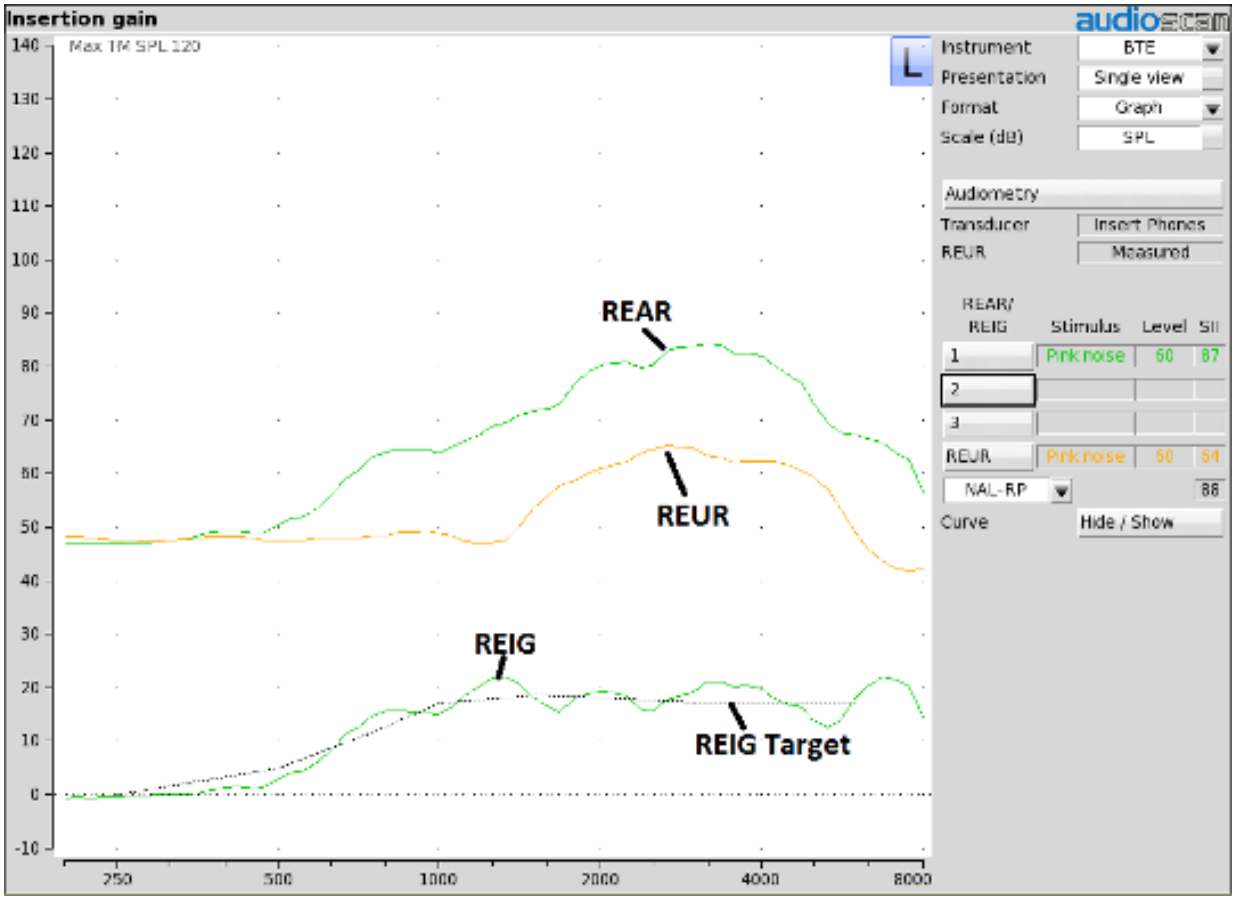

Figure 1. Example of a real-ear aided response (REAR) measurement, obtained with a 60 dB SPL pink noise signal. Also shown is the previously measured real-ear unaided response (REUR) measurement, along with the resulting real-ear insertion gain (REIG)

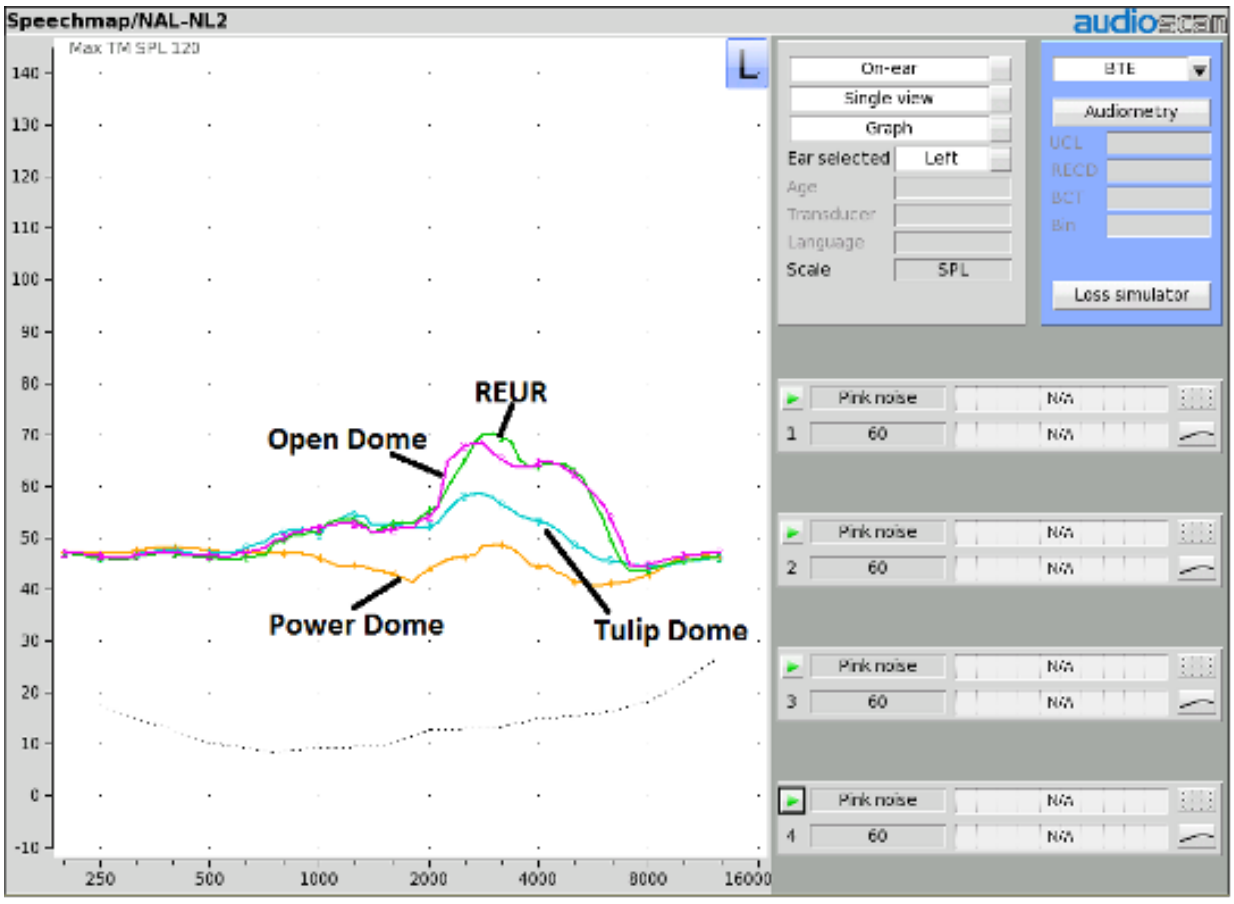

Figure 2. Example of real-ear occluded response (REOR) measurements (i.e., REM with hearing aid in

place turned off) for various device venting conditions. Shown is the previously measured REUR, along with REOR measurements for an open dome, tulip/closed dome and a power/occluding dome. Note the reduction in the measured response relative to the REUR as venting is decreased and the ear canal becomes more occluded.

While REIG calculations with non-occluding fittings may seem problematic, Mueller and Ricketts (2006) note it is still valid to subtract the REUR/G from the REAR despite the fact the external ear canal resonance is not impacted. That said, they note the required amount of hearing aid gain to achieve a given REIG target will vary depending on how much residual ear canal resonance is available to “help out” the REAR portion of the measurement. Consider that the REAR used during the REIG calculation will reflect both the unaided, vent-transmitted path and the aided, amplified path. Therefore, for a given REIG target, the REAR component with more open fittings would generally require less amplifier gain than more occluding fittings due to increased residual ear canal resonance. Also, insertion gain cannot be calculated without subtracting an REUR/G from the REAR, and the REUR/G does not change regardless of the hearing aid coupling. All of this noted, Mueller and Ricketts state ‘it is still okay with an open fitting to subtract the REUR/G from the REAR as this approach is interested in the gain the patient obtained, even if the patient still has their natural gain in place with the coupling in question.’

References

1. Mueller, H. G., & Ricketts, T. A. (2006). Open-canal fittings. Ten take-home tips. The Hearing Journal, 59(11), 24.26,28-32,34,36-39. https://doi.org/10.1097/01.HJ.0000286216.61469.eb
2. Pumford, J. (2018). Considerations in real-ear measurement: Points to Ponder. Canadian audiologist. 5(3). Retrieved from